Peer Review Comments on Sections 1 and 4 of EPA's Draft Document
Approach for Estimating Changes in Blood Lead Levels from Lead Wheel Weights

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I. GENERAL IMPRESSIONS

Regarding Section 4 "The Near-Roadway Exposure Scenario", the approach, methodology and assumptions were appropriate and scientifically based. I was particularly pleased to see all the assumptions clearly stated and scientifically defended. In short I have no disagreement with the assumptions or the overall methodology. Figure 3, though complicated and perhaps in need of some improved graphical intervention, is very good and lays out the approach in a straightforward and logical fashion. I found myself returning to that graphic often.

My concern is the omission of another pathway, namely "degraded LWW" to "roadway dust" to "air dispersion" to "household dust deposition (floors and window sills)". While all the other exposure pathways have been addressed in a very systematic and thorough fashion, this pathway seems to have been omitted. I was pleased to see the "Yard Soil Module" but believe the pathway above may be much more significant; especially in urban areas.

No doubt you are aware of some of my research in quantifying urban lead dust fallout[1] [2] as well as Lead in Urban Roadways[3]. While we did not present mathematical models for the transport and deposition of lead in roadway grit to window sills/floors in these papers, I strongly believe the air uptake of very fine particles into local residences is occurring (at least urban areas). A colleague, Mark Laidlaw, has just published a paper (*Re-suspension of lead contaminated urban soil as a dominant source of atmospheric lead in Birmingham, Chicago, Detroit and Pittsburgh, USA*) on this transport pathway (as have others, Mielke) in *Atmospheric Environment* last November.

In summary, the approach, methods, data and conclusions presented in Section 4 are scientifically defensible and completely appropriate. This scenario suffers from the very challenging task of relying heavily on one published article for the exposure assessment, namely Root 2000. However, the authors and researchers clearly and repetitively disclose this limitation. Their conclusions based on the available data are sound. My main concern is the omission of an additional exposure pathway; i.e. direct transport from re-suspended roadway dust to household dust.

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[1] Caravanos J, Weiss A, Jaeger R; *Long Term Exterior Dust Lead Loadings in New York City*; Environmental Research, Vol 100(2): pp 159-164; February 2006

[2] Caravanos J, Weiss A, Blaise M, Jaeger R; *A Survey of Spatially Distributed Exterior Dust Lead Loadings in New York City*; Environmental Research, Vol 100(2): pp 165-172; February 2006

[3] Weiss A, Caravanos J, Blaise M, Jaeger R; *Distribution of lead in urban roadway grit and its association with elevated steel structures*; Chemosphere, Vol 65: pp 1762-1771; December 2006

II. RESPONSE TO CHARGE QUESTIONS

Charge Question 1: Approach for Near Roadway Scenario

Question 1. Please comment on the overall approach for the near roadway scenario. Are the modules, default scenarios and assumptions reasonable and adequately supported by relevant scientific data? If not, specifically note why assumptions are unreasonable and provide suggestions and references to support alternate default assumptions.

Comments on Modules:

1. The creation of the modules is smart and enables readers to easily see the components addressed.
2. Fig 3 graphic is very good but could be improved with some color or images that clearly distinguish each "box."
3. Of course one module (or pathway assessment) that is missing is "roadway dust to settled household dust via direct air transport" (i.e. by-passing the Yard Soil module). As a NYC resident living on the 5th floor, I am constantly surprised by how much dust settles on my windowsill and floors each day. This is especially true during the warmer months. In rural areas, this is not the case (I've lived in central NJ where exterior dust is not readily settling inside). We were able to quantify lead dust deposition in our Feb 2006 paper during a 2-year period. To quote from the paper "The sampling analysis revealed that the median values of leaded dust for the interior plate (adjacent to a slightly open window), unsheltered exterior plate, and the sheltered exterior plate were 4.8, 14.2, and 32.3 μg/feet^2/week, respectively." Therefore, we were able to quantify a lead dust deposition rate on interior window sills of approximately 5 micrograms per square foot per week. Keeping in mind that this deposition is cumulative.

Comments on Scenarios:

1. The 5 scenarios chosen are appropriate and adequate for this assessment
2. The proxy cities are appropriately chosen and with the exception of the SW USA, are representative of the US

Comments on Assumptions:

1. Generally acceptable and no serious omissions observed.
2. (see detailed comments below)

Charge Question 2: Vehicular Wheel Weight Loss Rates and Abrasion Rates

Question 2. Please comment on the use of the Root (2000) study to determine the wheel weight throw rates and abrasion. Are the data from the Root (2000) study reasonably used and adequately transparent? If not, specifically note how the data should be used and provide suggestions and references for alternative data usage or sources.

Comments:

While unfortunate that Root 2000 offers the only research on this question, it may be possible to conduct some mass balance studies on LWW from the manufacturers perspective. I have personally spoken to automotive brake repair and tire service establishments and they readily reveal the high number of missing LWW and continuous re-installation during tire repair or balancing. Another limitation with the Root 2000 report is the geographic and climatic variables.

Albuquerque New Mexico is hardly representative of the entire US, in term of both climate and traffic patterns. It's also not clear what percentage of the LWW retrieved by Root were from trucks / cars or motorbikes. However, I understand you must work with what is available and Root's work in 2000 is the only report available.

Charge Question 3: Estimation of Lead Dust Generation from Roads

Question 3. Please comment on the approach for estimating lead dust emissions generation from the roadway. Is the approach for estimating lead dust emissions reasonable and supported by available information? If not, specifically note how the data should be used and provide suggestions and references for alternate data usage or sources.

Comments: (see specific observations below)
I agree with the use of the steady-state mass balance model for estimating LWW dust levels and do not have any conflicts or suggestions. However, it does not seem onerous to conduct some empirical studies to better understand LWW degradation in different environments.

III. SPECIFIC OBSERVATIONS

Provide specific observations, corrections, or comments on the document, mentioning page, paragraph, and/or line number.

1. Types of vehicles, I don't see mention of trucks. Not only do they have more wheels (therefore wheel weights) but the weights are heavier. When you say "cars," am I to believe trucks and motorcycles were not included? Is so, this should be clearly stated. A word search for "trucks" failed to yield many results (just Table 11).
2. The absence of a cleaning history from Root's 2000 study is unfortunate, but quite significant. I see this as a possible serious criticism of future evaluations. However, your general approach seems to be "worst case scenario."
3. My suspicion is that urban dwellers are not likely to retrieve LWW for hobby use. Melting Pb in dense housing and apartments is improbable. However, it is not unlikely that "scavengers" are collecting LWW and recycling them for cash. Though I have absolutely no empirical evidence for this, my recent observation is that the hard economic times have seen an increase in urban scavengers (bottles, cans). As an aside, I frequently pick up LWW from NYC (Manhattan) streets and store them in my laboratory (i.e. my own personal intervention strategy).
4. Page 20, Paragraph 3 – the assumption that all LWW (unless collected) degrade is appropriate. The oxide formation is continuous and easily crumbled.
5. Page 21, Paragraph 4 – LWW also contain a metal clip that is not accounted for or mentioned here.
6. Overall, the Steady State assumptions (generation, decay, transport) are reasonable and appropriate.
7. Page 23, Figure 3 – good start, but may I recommend some professional graphic artist complete it. This image displays an important concept and needs to be both simplified and clearly understandable.
8. Page 26, Paragraph 4 – 100% cleaning efficiency in removing LWW may be unreasonable. Is any cleaning 100%? Remember, these weights are small, dense and not easily vacuumed up. Unless physical rolling brushes are used, they may remain for

several cycles.

9. Page 27, Table 2 – Are highways (interstates) not included? Perhaps a sentence explaining why? I ride a motorcycle and when stuck in highway traffic, I observe significant amounts of LWW. Highways are also not scrubbed at the same rate as local streets.
10. Page 28 – my research (though limited) has observed that Pb is dominant in the small particle sizes (see photo and data below). Even though by weight this faction is the smallest (only 7% of the mass of total roadway grit) it contains the highest % of lead and most importantly, it is the faction that is aerosolized and distributed.
11. Page 29 – Miles Traveled section: no concerns here as I assume your data sources are authoritative.
12. Page 30 – A paragraph on AERMOD should be included. The authors should not assume that all readers are familiar with this modeling software and its application. One paragraph should suffice.
13. Page 30, Table 4 – a very important table, but units need to be identified. I suspect the last column is grams per square meter per second (correct?). This unit generates very low emission rates. Perhaps you should consider readjusting to … per hour or day? Makes for a more intuitive result.
14. Page 30, Figure 7 – to the right of the AERMOD Dispersion Model Box, perhaps you can identify the text "Receptor grid, land use….." I believe the word "INPUTS" before this narrative would help the reader understand what those words relate to.
15. Page 31, Paragraph 2 – several times in the report you state "data driven, available inputs, etc." Reviewers may determine that the data determined the analysis. While I realize this is partly true, it gives the sense that "you took the easy way out… picking low hanging fruit" etc. Given this difficult assignment, you had to make many assumptions and use what was available. However, do not undermine yourselves by bringing more attention to this as is necessary. See also P32, para2, line9.
16. Page 32, Paragraph 3 – I'm having trouble understanding: 3 yards x 2 yards per square block. Exactly what is that?
17. Page 32, Paragraph 5 – I'm not sure you need to state this multiplication / division exercise? May confuse readers and doesn't provide any useful information. But at least you're being transparent.
18. Page 33, last paragraph (building height) – very good… Your attention to this detail instills a sense of professionalism and thoroughness.
19. Page 36, Table 7 – logically it would go "Urban, Suburban, Rural." Be consistent.
20. Page 36, Table 7 – many high density urban areas do not have yards (apartment buildings). What accommodation for this have you done?
21. Page 39, Paragraph 2 – Bowen Ratio, Albedo are meteorological terms that should be defined (one sentence each should be enough).
22. Page 40, last paragraph – Is there no better roadside particulate distribution research than Samara and Voutsa from Thessaloniki, Greece? Hard to believe USGS doesn't have more applicable data. Using such distant soil data undermines your work.
23. Page 43, Paragraph 2 – strongly recommend you look at Laidlaw/Mielke paper (Nov 2011) and address this issue. While I agree yard resuspension may be low in Northeast USA, in Tucson, LA and other arid climates, it may be significant.
24. Page 43, Paragraph 3 – a soil thickness of 1cm seems unreasonable. Not sure whether you used 1 or 10 cm. Needs clarification.

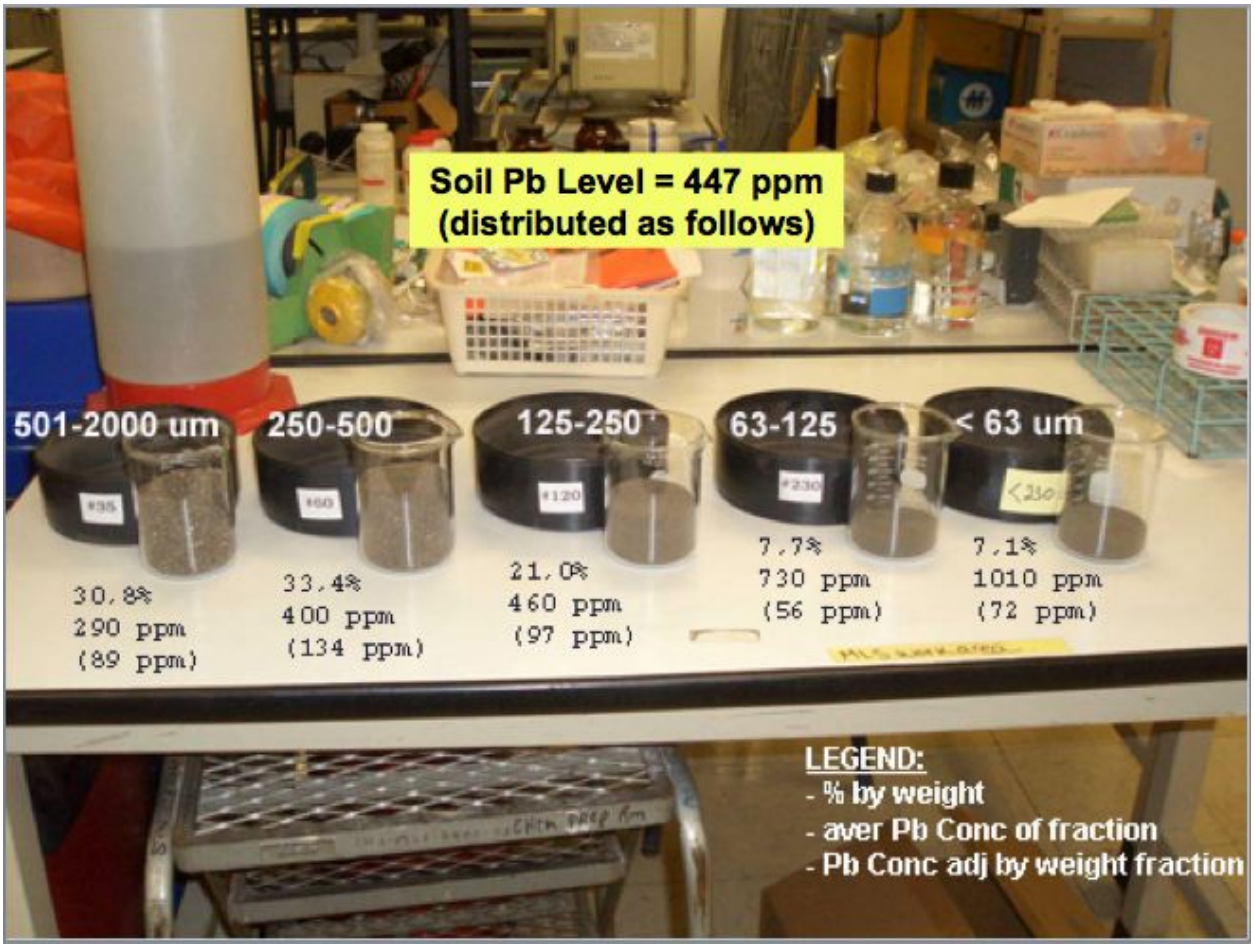
25. Page 44, Table 12 – not clear what response/removal/residence really means under the "Reported Time (yrs)" column. I understand half-life, but the others should be described.
26. Page 45, Table 13 – I have taken hundreds of Pb soil readings/measurements and the value of 1,463 ppm for urban high soil seems a bit high. However, if it comes from a scientific source and represents the neighborhood you are studying, then I'll accept it. Also keep in mind the US EPA soil guideline (bare soil, child contact) is 400 ug/g.
27. Page 46, Paragraph 2 – The sentence "The concentration of lead in indoor dust…" is also determined by roadway dust re-suspension. This should be modeled (commented earlier).
28. Page 50, Paragraph 1 – A penetration factor of 1.0 (100%) seem acceptable for small particles and fumes.
29. Page 51 – I agree the IEUBK model is more appropriate and authoritative than Leggett.
30. Page 66 – UNCERTAINTIES
    1. Root 2000 study – given this is the only study available, it's reasonable to use it in its entirety. I agree with the statement "likely that degradation mostly occurs on the roadway…". My own personal observation is that this is true. But I do question the efficiency of street cleaning efforts to collect the LWW. This will be a function of the type of equipment used.
    2. All degraded lead is emitted to air – while rain will wash degraded LWW dust, it will merely be moved downstream and not completely "washed away." Another issue that has not been addressed (at least I did not see it) is the re-suspension, deposition, then re-suspension again on the roadway. Automobile traffic produces a steady air stream that can create this cyclic re-suspension / deposition.
    3. Dust concentration in the home is not correlated with ambient air concentration – this is a limitation that likely underestimates BLLs. In addition, the absence of the roadway dust source to household surface dust also underestimates blood lead levels.
    4. Use of proxy cities – the selection and use of the proxy cities is appropriate and reasonable. I believe they are representative of northeast communities, but I am concerned about the absence of southwest arid cities where Root's original research began. Fortunately, the proxy cities selected had adequate AERMOD data which facilitated analysis.
    5. Exclusion of yard soil re-suspension – acceptable and not likely to significantly impact the BLLs.
    6. Application of blood models – I have reviewed dozens of cases of lead poisoned children (usually lead-based paint, but many with soil and dust exposures) and generally do not see BLL report to two decimal points (i.e. 21.46 BLL). My understanding of the analytical methods used generally limit the reporting to 1 significant figure (7.4 not 7.40).

31. Page 69, Table 24 – In general, I was a bit surprised to see such low BLL impacts due to LWW. Given the quantity of LWW "released" in the environment per year, my intuition leads to greater impacts. I do not question the assumptions or data but rather whether all pathways have been fully explored. LWW dust re-suspension onto clothing, food, housing surfaces are all possible. But most importantly, the omission of LWWD to household surface dust deposition maybe the largest omission.

32. ALSO, I suspect regulators, toxicologist, geologist, statisticians, etc. will all be reading

the final report. So ask yourself, will environmental scientists understand the IEUBK section? Have I defined all relevant terms? Seems to me that terms and concepts in this report need to be better defined and targeted for a wide range of people (scientist and lay).

33. Given the many uncertainties (LWW degradation rate, effect of speed, particle size analysis, etc.) perhaps conducting some testing may be in order. There are many simple scientific questions that could be easily answered in a relatively short time. But I realize this may be out of scope.



From ER 2006, Roadway grit paper:
Sieve sizes (left to right) – 35, 60, 120, 230, <230
Total lead in dry roadway grit – 447 ppm (distributed as 89+134+97+56+72 ppm in each sieve size)
Observation: the finest dust (<230) contained the highest percentage of Pb, ie dispersable)